Course Code: ARI5004

Course Name: Deep Learning

SYLLABUS[1]

Instructor

Office : D531
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Office Hours: : Tuesday 16.00 – 17.00
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Course Information

Period : Fall
Time : Wednesday 19.00 – 21.50
Course Credit / ECTS : 3 / 6
Classroom : D305
Mode of Delivery: : Face to Face
Course type : Departmental Elective
Course ECTS Page Link :

Course Objectives

Deep learning has become a primary tool for AI tasks in different domains such as computer vision, pattern recognition, natural language processing, machine translation, bioinformatics, and game playing. It has penetrated different industries, like healthcare, finance, self-driving cars, entertainment, social media, and games, with its enormous potential impact. As a result, it has become a highly demanded skill in both research and industry.

In this course, we will learn the basics of neural networks and their applications in various domains. The course will mainly focus on supervised learning-based methods. It will start with multi-layer perceptrons and gradually and eventually discuss more advanced topics such as attention and transformers.

Course Learning Outcomes

By the end of the course, students are expected to know the fundamentals of Deep Learning and be able to apply Deep Learning to different tasks. Besides, they will have a strong basis enabling them to understand the related work in the literature and extend it through further studies.

Contribution of the Course to the Program

This course will provide students with theoretical and practical background in deep learning. It will help students use theoretical and applied knowledge to identify, define, formulate, and solve problems using deep learning techniques and tools. Besides, it will contribute to students' skills and abilities in conducting experiments including data collection, analysis, and interpretation.

[1] It is essential that the syllabus announced at the beginning of the term is not changed except when necessary. When a requirement occurs, the curriculum can be changed by the lecturer of the course by notifying this situation in writing or verbally beforehand. It is the student's responsibility to follow the current program.

Course Structure

The course consists of two main components: learning foundations of deep learning and gaining hands-on experience in implementing the deep learning models. We will learn the foundations via in-class discussions. Each lecture will have some resources that will provide us with the details of the topic. These resources will be made available before the class, and you are strongly urged to go through them before the in-class discussion. We will gain hands-on experience by implementing the concepts and building deep learning models using PyTorch as an integral part of the classes.

Course Policies

Communication Channels and Methods:

All the communication (announcements, discussions, submissions, etc.) will go through Itslearning course site.

- You are strongly encouraged to post your questions and comments in the course's discussion forums. If you have any personal issues that you cannot post in the course discussion forum, you can contact your instructor via email.
- You must submit all your work via Itslearning course site. Hard copy submissions and submissions via email will not be accepted.

Usage of Digital Tools:

You are requested **NOT to use** your electronic devices (phone, tablet, laptop etc.) in the class.

Attendance:

Attendance is not compulsory, yet highly recommended. There is a strong correlation between class attendance and success in the course since it provides a unique experience of interaction and discussion, which promotes learning. Class attendance and contributing to the discussions will be awarded up to a 5% bonus.

Disabled Student Support:

You can contact me directly regarding the issues that may be an obstacle for you (vision, hearing, etc.). In addition to this, there is a Disabled Student Unit to minimize the difficulties that our disabled students will encounter due to their disabilities and to eliminate the obstacles. You should contact this unit regarding your situation.

Oral and Written Communication Ethics:

You have to express yourself respectfully in your communication with everyone in the class. In addition, you are responsible for maintaining this respect in discussions and correspondence on the online platform.

Privacy and Copyright:

In accordance with the Personal Data Protection Law, it is strictly forbidden to register the participants (students and instructors) during the course.

Course Resources

There are no specific books or resources that we will follow in this course. Yet, some recommended sources are listed below. Apart from that, we will have different resources specific to each topic. These resources will be made available through Itslearning course site at least one week before the class that the topic will be covered.

Type	Name	Description
Textbook	Deep Learning (Goodfellow et al., 2016)	The Deep Learning textbook is a resource intended to help students and practitioners enter the field of machine learning in general and deep learning in particular.
Textbook	Dive into Deep Learning (Zhang et al., 2021)	Interactive deep learning book with code, math, and discussions
Framework	PyTorch	An open-source machine learning framework that accelerates the path from research prototyping to production deployment.

Additional Resources:

Additional resources will be announced/made available via Itslearning course site.

Grading and Evaluation

Assignment	Description	Scoring	Weight (%)
Weekly Quizzes	• There will be 7 biweekly quizzes, weighted equally. • Your best 6 out of 7 quizzes will be retained. • Quizzes will generally (but not always) be released on Friday and due 72 hours later. • Each quiz may cover the topics of previous weeks and the next week. • Quizzes may contain multiple-choice questions, True/False questions, written questions, or programming questions. If there are any written questions, solutions must be in PDF format and typeset in LaTeX. ○ Overleaf, an online LaTeX editor, is strongly recommended in writing solutions: https://www.overleaf.com	100	24
Programming Assignments	• There will be three programming assignments, weighted equally. • Programming parts will be auto graded using scripts. You must follow the submission guidelines; otherwise, you may get zero. • Programming assignments may also include written parts. Solutions to these parts must be in PDF format and typeset in LaTeX. • Selected solutions will be invited to present in the class.	100	30

Final Project	• **Paper selection and project proposal**
	  ○ Papers list will be announced in the third week
	  ○ **Deadline: 08.11.2022 @23.59**
	  ○ The proposal is subject to your instructor's approval. If your proposal is not good enough for the course project, you may need to change it.
	  ○ The project will be conducted as a group of two people. You are required to form your group by the proposal deadline.
		100	6

	○ The proposal is strictly limited to **two pages including references.** ▪ Should include: Introduction (problem statement and importance), Related works (what has been done), Materials and methods (what will be done), Summary and references		
	• **Midterm presentation** ○ **Deadline: 07.12.2022 @class** ○ It is strictly limited to **5 minutes.** ▪ Should include: Introduction, Related works, Materials and methods, Preliminary results, Discussion (next steps)	100	10
	• **Final code and report submission** ○ **Deadline: 17.01.2023 @23.59** ○ The report is strictly limited to **five pages including references.** ▪ Should include: Introduction, Related works, Materials and methods, Results, Discussion, References ○ Code must be deposited at GitHub and have a step-by-step explanation in README to reproduce the results.	100	20
	• **Final presentation** ○ **Deadline: 18.01.2023 @class** ○ It is strictly limited to **10 minutes.** ▪ Should include: Introduction, Related works, Materials and methods, Results, Discussion, References	100	10
	All write-ups must be in PDF format following NeurIPS paper style: ○ https://neurips.cc/Conferences/2022/PaperInformation/StyleFiles ○ Online editors such as Overleaf may be helpful in writing reports: https://www.overleaf.com.		
Contribution Bonus	• Attending the lectures and contributing to the discussions will be awarded a 5% bonus. • The bonus will be prorated based on the number of weeks a student contributed to the lecture. • The followings during a lecture are accepted as a contribution: ○ Asking at least one question ○ Commenting on a subject at least once	100	5 [bonus]
TOTAL			100

Late Submissions:

You are given a total of 7 free late (calendar) days. You can use your late days **only in quizzes and programming assignments**. They do not apply to project items (i.e., project proposal and final code/report submission). Each late day is bound to only one assignment. For example, if you submit one quiz and one programming assignment 3 hours after the deadline, you will be charged for 2 late days.

Once you run out of late days, your late submissions will be penalized 20% per late day. However, submissions will not be accepted more than 3 days after the deadline.

Project items (i.e., project proposal, midterm presentation, final code/report submission and final presentation) have hard deadlines unless you have a valid excuse (like a medical report). Please comply with the deadlines of those items to avoid unpleasant situations.

Course Calendar

Resources will be announced/made available via Itslearning course site.

Week	Course Topic	Assignments
W1	Introduction to Deep Learning Learning and intelligence Machine learning (ML) and ML taxonomy (unsupervised to supervised) ML tasks (generative vs. discriminative) Linear separability (decision boundary) Linear transformation (matrix multiplication) Data space vs. feature space	
W2	Artificial neural networks Activation functions Multi-layer perceptron Shallow vs. deep networks NNs are universal approximators	Quiz1
W3	Training neural networks Gradient descent Backpropagation	Project papers list will be announced
W4	Loss functions Optimization (Learning rate and optimizers - SGD, ADAM, etc.) Loss surfaces Weight initialization	Quiz2
W5	Full cycle of a deep learning project Diagnostics of neural networks (overfitting vs. underfitting / memorizing vs. generalizing / bias vs. variance) Hyperparameter tuning Regularization (weight decay, dropout)	Project proposal due Assignment-I release
W6	Convolutional neural networks Image filtering Parameter sharing Hierarchical representations Pooling Receptive field	Quiz3
W7	Normalizing inputs and activations Batch normalization Residual connections Training and visualizing CNNs	
W8	Modern CNN architectures Applications of CNNs	Quiz4
W9	Recurrent Neural Networks (RNNs) Parameter sharing Unrolling and backpropagation	Midterm presentation Assignment-II release
W10	Training RNNs Long Short Term Memory (LSTM) Gated Recurrent Units (GRUs)	Quiz5

W11	Applications of RNNs	
W12	Attention and Transformers	Quiz6 Assignment-III release
W13	Advanced topics in deep learning I / Buffer I	
W14	Advanced topics in deep learning II / Buffer II	Quiz7
W15	Final project presentations	Project report due

Matters Needing Attention

- Read all weekly course materials before coming to the class.
- Take the quizzes to review the topics and get prepared for in-class discussions.
- Attend the lectures actively every week.
- Participate in and contribute to in-class activities and discussions.

Academic Integrity, Cheating and Plagiarism

Academic integrity is a serious matter in this course. Any violation will be reported to the university's highest levels and maximum punishment will be argued for.

You are encouraged to form study groups to discuss quizzes and programming assignments. However, you must write down your own solutions without referring to the notes taken during discussions. It is a violation of academic integrity to copy, refer to or look at written solutions and code from another student or any other sources. It is also a violation of academic integrity to post your solutions and code online. Besides, you should write down the names of your collaborators in your submissions.

You are expected to comply with the University Policy on Academic Integrity and Plagiarism. Violations of the university policy can result in severe penalties, including failing this course and possible expulsion from Bahçeşehir University. If you have any questions about this policy and any work you are doing in the course, please feel free to contact your instructor for help.

ARTICLE 25 – (1) In case it is doubled that a student cheats or attempts to cheat, commits plagiarism or similar violations defined in the applicable disciplinary regulation in any exam, assignment or other assessment activities, a disciplinary proceeding is brought against the student. Such activity is not assessed during the proceedings. A student who is found guilty is assigned zero point in addition to the disciplinary punishment. If the student is found innocent because of disciplinary proceeding, the exam taken by the student shall be assessment or a make-up exam or activity is provided.

You can access Bahçeşehir University and Higher Education Institution Regulations by clicking this sentence.

Prepared by: Mustafa Ümit ÖNER
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